SB761
U7N6
76-24

the WESTERN SPRUCE BUDWORM PROBLEM in Idaho and Montana 1976

FOREST ENVIRONMENTAL PROTECTION
USDA · FOREST SERVICE · NORTHERN REGION
State & Private Forestry · Missoula, MT 59801

Prepared by

U.S. Department of Agriculture
Forest Service/Northern Region
State and Private Forestry
Forest Environmental Protection
Missoula, Montana 59801

November 1976 R1-76-24

W E S T E R N S P R U C E B U D W O R M

in Idaho and Montana, 1976

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Status, impacts, and control alternatives for

Western Spruce Budworm in Idaho & Montana

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November 1976

U.S. Department of Agriculture
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THE WESTERN SPRUCE BUDWORM IN IDAHO AND MONTANA
STATUS, IMPACTS, AND ALTERNATIVES FOR 1976

The western spruce budworm is one of the most widely distributed and destructive species of conifer-feeding insects in western North America. A native pest, it was first discovered in the 1800's. Visible defoliation has been reported each year since 1922 on at least one Forest Service Ranger District in the Forest Service's Intermountain and Northern Regions. Many outbreaks of western spruce budworm have been reported in the past 50 years in stands of Rocky Mountain Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), true firs (*Abies* spp.), Engelmann spruce (*Picea engelmannii*), and western larch (*Larix occidentalis*) in the Intermountain and Northern Rocky Mountain Regions. Occasional hosts include mountain hemlock, western hemlock, lodgepole pine, ponderosa pine, and western white pine.

Tree Mortality

Surveys of tree defoliation and tree mortality in some National Forests show the effects of budworm feeding on trees including: reduction of annual growth; top kill resulting in loss of the cone-producing area; destruction of cone and seed by larval feeding; and tree mortality.

Budworm research efforts have been concerned chiefly with the insect's population dynamics, behavior, genetic characteristics, and how it can be managed. Few investigations have involved the budworm's relationship with host species or patterns of its outbreaks. There is considerable information available regarding the chronology, geographic distribution, and severity of many of the budworm outbreaks.

What is budworm?

The budworm moth usually develops from egg to adult in 12 months. Moths are about ½ inch long, with gray-brown or orange forewings, marked with bands or streaks, and each usually has a conspicuous white dot on the margin of the wing (Fig. 1). Wingspread is from 1 to 1½ inches. Moths usually emerge from pupal cases in July or early August. Shortly afterwards, they mate. Females deposit egg masses on needles of host trees. The adult moth does not feed during its short life.

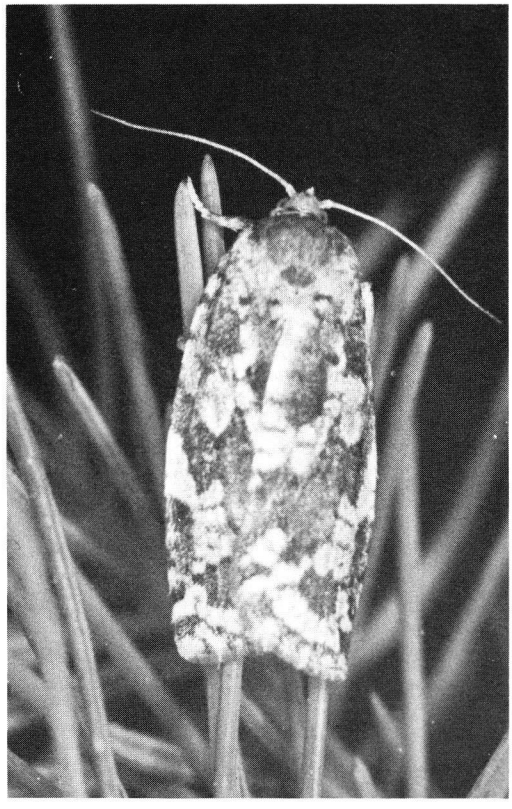


Figure 1.--Adult western spruce budworm

Eggs are oval, light green, and about 1/16 inch long. They are deposited in masses in July and August on the undersides of needles. Individual eggs overlap like shingles in the egg mass (Fig. 2). Each egg mass contains 25 to 40 eggs. A female lays approximately 150 eggs. They hatch about 10 days later.

Dormant in Winter

Tiny, first instar[1/] budworm do not feed but seek hiding places among lichens or under bark scales on limbs or the bole of host trees. Here they spin a silken shelter (hibernacula) in which they remain dormant over winter.

1/ Instars are the spans between the time the larvae shed their skins as they grow.

Figure 2.--Western spruce budworm egg mass

Usually there are six larval instars. Newly hatched larvae are green with brown heads. During the next three instars, larvae have black heads and collars and the body is orange-brown or cinnamon-brown. Fifth instars have reddish-brown heads marked with black triangles, a black collar, and a scale-green body marked with small, whitish spots. Full-grown larvae (sixth instar) are 1 to 1½ inches long, with tan or light chestnut-brown heads and collars, and a body with large, ivory-colored areas superimposed on olive-brown or reddish-brown (Fig. 3).

Feed in Spring

Larvae emerge from their winter shelter in the spring and move to the foliage where they tunnel into needles and feed for 7 to 14 days. About the time buds start to swell, larvae leave the old needles and bore into expanding buds. As buds and shoots unfurl, larvae spin loose webs between needles and tips. They feed on new needle foliage and entirely destroy needles and tips within the webs. Then they return to feed on older needles. Larvae are full grown in 30 to 40 days. They change to pupae (Fig. 4) either in existing webs or webs they spin in other places on the tree.

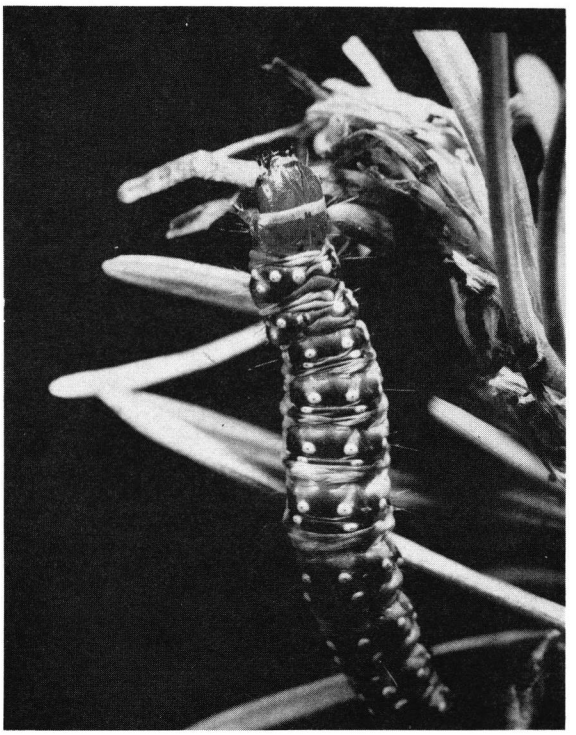


Figure 3.--Western spruce budworm larva, in sixth instar (full grown).

Pupae are about ½ inch long, broad at the head end but tapering rapidly toward the tail. They are brownish-yellow or brownish-green when first formed and later turn reddish-brown.

What trees are damaged?

Common hosts are Douglas-fir, grand fir, white fir, subalpine fir, blue spruce, and Engelmann spruce.

Evidence of infestation varies with season of year. In spring, before shoot growth begins, the absence of needles on year-old shoots may indicate feeding activity the previous year. Close examination may disclose small larvae mining needles or swelling buds with silken webs at points of entry. As shoot growth begins, adjacent shoots are often webbed together, and other shoots appear twisted or stunted.

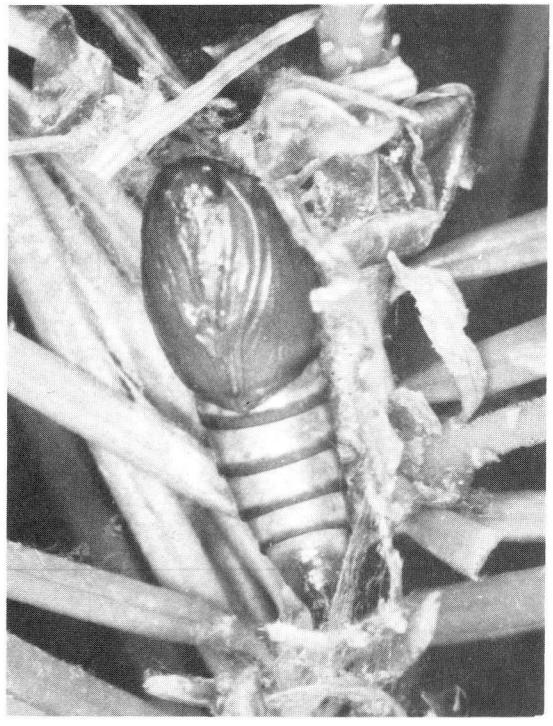


Figure 4.--Western spruce budworm pupa.

Webbed branch tips turning reddish-brown in early July indicate the presence of full-grown larvae. Infested stands viewed from a distance appear to have been singed by a light, crown fire. Discolored foliage is removed by fall rains. Bare tips indicate budworm feeding.

Infestation Impacts

Practically all new needle growth and a large portion of the buds and new shoots may be destroyed during budworm outbreaks. Young fir stands in budworm infestations suffer heavy damage; understory trees in particular are severely defoliated.

After 4 or 5 years of sustained attack, many trees are almost entirely defoliated and growth sharply declines. Some trees start to die, beginning at the top. Top killing destroys trees' cone-producing areas. Entire cone crops can be eliminated in Douglas-stands by budworm feeding directly on cones. Mortality is more rapid in small understory trees than in pole-size or larger trees. However, pole-size trees can be killed by budworm within 7 years. Trees weakened by budworm defoliation may be infested by bark beetles, or infected by stem decay fungi, which can eventually kill them.

What other kinds of impacts may occur as a result of the foliage losses and trees dying?

Tree mortality caused by budworm larvae can also influence timing and amount of runoff, particularly during snowmelt. Dead and dying trees create a fire hazard and fuels on the forest floor dry out faster when shade from the overhead canopy is gone.

Where defoliation is severe, the thinning of tree thickets permits easier passage of animals and establishment of forage or browse plants on the forest floor and reduces shading and concealment for wildlife.

Quality of recreation areas can suffer from budworm feeding. Loss of tree cover in picnic and campground areas and undesirable esthetics result from heavy defoliation in much-used sites and thoroughfares.

Epidemic Buildup

A budworm infestation can last from 1 to 30 years, but most persist from 1 to 10 years.

While the rate of infestation spread has not accurately been determined, western spruce budworm adults are good fliers and can migrate to adjacent uninfested stands.

The budworm has many natural enemies, including wasp and fly parasites, birds, and adverse weather. When weather conditions are favorable for an increase in western spruce budworm populations, the combined effect of natural factors cannot prevent an outbreak. During prolonged infestations, starvation can be important in causing larval mortality since there are not enough green needles left in infested areas to sustain the population.

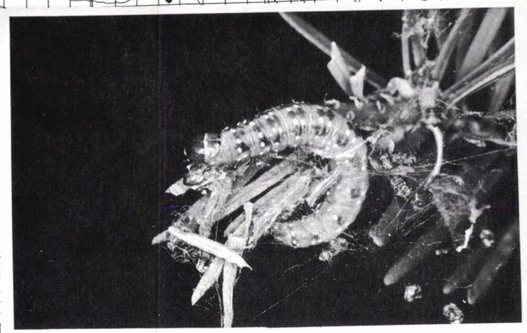
Approximately 3.3 million acres are now infested (Fig. 5) in the Forest Service's Northern Region; Montana and northern Idaho. In the Intermountain Region--southern Idaho--approximately 0.7 million acres are infested (Fig. 5).

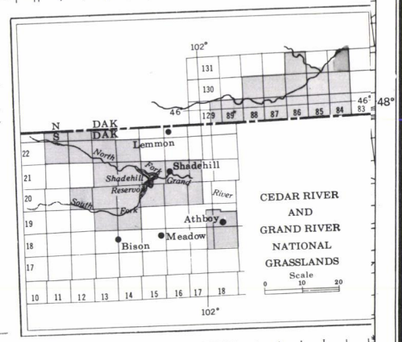
Outlook for 1977

Aerial detection surveys in 1976 indicate that defoliation and intensity of damage will increase in 1977. However, egg mass surveys in September of 1976 will provide needed data for more accurately predicting 1977 defoliation.

WESTERN SPRUCE BUDWORM INFESTATIONS

INTERMOUNTAIN AND NORTHERN
FOREST SERVICE REGIONS
1976





LEGEND

- Regional Headquarters Missoula, Montana
- Forest Supervisors Headquarters
- National Forest Areas in Region One

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
JOHN R. McGUIRE, CHIEF

NATIONAL FORESTS
REGION ONE
1975

Scale
20 10 0 20 40 Miles

Prepared at Regional Office, Missoula, Mont
Revised September, 1962

The resource manager has three basic management alternatives available to cope with the western spruce problem:

1. No treatment. Accept the consequences of defoliation and rely on natural factors to end the outbreak. Continue assessment and accounting for growth loss and mortality. Continue assessment of beneficial effects on age class distribution, other species, and resources.

2. Timber management techniques. Reducing budworm host trees could reduce the insect populations. This would require either reduction of the Douglas-fir/true fir stocking to a very low level or a change in stand composition to favor pine. In ecologically appropriate areas, ponderosa or lodgepole pine could be favored over Douglas-fir to comprise 50 percent of the residual stands in small acreages. Harvesting to reduce the true fir complement in budworm-infested stands--cutting Douglas-fir, and true fir, and burning cutting units to favor pine over all firs--might prevent or reduce budworm infestations. Patch clearcutting, with cutting units kept as small as practicable, would probably increase first and second instar budworm dispersal losses. Maintaining thrifty, fast-growing stands would aid budworm management. Trees genetically resistant to the budworm are a thing of the future.

3. Apply insecticides to reduce budworm populations.

Two registered pesticides are currently available for budworm management: Malathion and Sevin.

Malathion ULV is an organophosphate material manufactured by American Cyanamid Company (EPA Reg. No. 241-110AA). It is toxic to many species of insects, and persists for about 7 days under field conditions. It is widely used in forestry and agricultural spraying. Malathion is currently registered for use in the management of the following insects: western spruce budworm, European pine sawfly, and larch casebearer. The registered dosage rate per acre is 13 fluid ounces of 95 percent technical active ingredient per acre.

Sevin 4-Oil is a carbamate material manufactured by Union Carbide Corporation (EPA Reg. No. 1016-70). It is also toxic to many species of insects and persists for about 14 days under field conditions. It, too, is widely used in forestry and agricultural spraying. Sevin 4-Oil is currently registered for forest insect management for the following insects: western spruce budworm, eastern spruce budworm, cankerworm, forest tent caterpillar, saddle prominent, gypsy moth, and oak leaf rollers. Sevin 4-Oil is applied at the rate of 1 pound active ingredient in sufficient oil to make 64 fluid ounces per acre.

Orthene Tested

The Forest Service has been laboratory, field, and pilot testing Orthene for the past 5 years to determine its effects on fish, wildlife, and other nontarget organisms; its persistence in the soil and water; and its long-term effects on living organisms.

Studies indicate that the dosage proposed for registration (1 pound active ingredient/acre) of Orthene poses little hazard to birds, fish, and mammals, either at the time of application or after prolonged periods of exposure. It is rapidly degraded by plants and soil organisms. Neither Orthene nor its breakdown products have been found to accumulate in any organisms examined from single-celled plants and animals to larger mammals and birds.

Field tests in 1976, near Spencer, Idaho, showed Orthene killed in excess of 96 percent of the western spruce budworm population. Pilot tests in the Helena National Forest in Montana in 1976 showed a 94 percent population reduction. Orthene is an organic phosphate produced by Chevron Chemical Company. Orthene kills by direct contact or by being injested by the budworm. It is registered for use against eastern tent caterpillar, forest tent caterpillar, gypsy moth, nesting pine sawfly, red-headed pine sawfly, many agricultural pests, and insects attacking ornamental trees.

Biological Control

Use of biological agents (viruses, bacteria, fungi, or microsporidia) to manage western spruce budworm is still in the research stage. The mode of action of *Bacillus thuringiensis*, a bacterium, on eastern spruce budworm larvae has been under investigation in Canada for several years. Initial field tests were made in 1959. Aerial applications have demonstrated that it can cause considerable budworm larvae mortality, but not at levels as high as those obtained with chemicals. Recent aerial applications of *B.t.* chitinase formulation showed a larval mortality rate high enough to suggest the possibility of using such a formulation for budworm management.

A systematic egg mass survey in the fall of 1976 will provide one basis for a management decision. This survey involved collecting two branch samples from each of three tree plots throughout budworm-infested areas in Montana and Idaho. Then new egg masses were counted on branches from which the defoliation for 1977 can be predicted. If egg mass counts and related entomological and management data meet criteria established by entomologists and land managers, these areas will be included in potential areas for management.

Management Criteria

Three criteria are followed in determining budworm management; (1) biological evaluation; (2) benefit/cost analysis; and (3) an assessment of environmental impacts of both the outbreak and action alternatives.

Biological evaluations are made by counting egg masses per 1,000 square inches of foliage to predict defoliation in 1977. Four to ten egg masses per 1,000 square inches of foliage will produce moderate defoliation in 1977. Eleven to forty egg masses per 1,000 square inches of foliage will result in heavy defoliation in 1977.

The ideal benefit/cost ratio of a western spruce budworm management strategy is to identify key resource values of the land, both timber and nontimber, project the adverse effects of continued defoliation, compare these impacts with the cost of any management effort. These evaluations, plus an examination of positive and adverse effects of alternatives--including the alternative of no treatment--leads the resource manager to a sound decision.

Acceptable Defoliation

Acceptable defoliation depends on management objectives for specific areas (e.g., timber, Christmas trees, recreation). Tree mortality and top kill are not acceptable under most management objectives. Top kill causes loss of cone production, weakens the tree and may make it susceptible to attack by bark beetles, and may provide entry ports for disease-causing fungi. Growth loss can be measured in actual board foot loss, and tree mortality, particularly in reproduction of pole-size stands. This measurement is important in predicting reductions in regeneration for the next rotation.

When To Spray

When larval development is from the third instar and larger, infested areas could be sprayed. This development usually occurs in July.

The final decision--to treat or not to treat an area--is made by those responsible for its management. Management objectives, such as fish, wildlife, seed production, esthetics, water supplies, timber, as well as the entomological criteria described above, are used by land managers in making these decisions. Wildernesses or primitive areas are treated only if these areas are heavily infested and threaten adjacent management units.

Advice and Assistance

In Montana, advice and assistance is provided private landowners through the Division of Forestry, 2705 Spurgin Road, Missoula, Montana 59801. In Idaho, contact the Department of Lands, P.O. Box 670, Coeur d'Alene, Idaho 83814.

What Should be Done?

As an individual concerned about the western spruce budworm epidemic, what do you think should be done? Let the Forest Service or responsible State agencies know your opinions and conclusions. Your ideas and comments will be considered in making a management decision about the western spruce budworm epidemic. Montana and Idaho National Forest Supervisors can be reached by writing to:

Beaverhead National Forest
P.O. Box 1258
Dillon, Montana 59725

Bitterroot National Forest
316 North 3rd Street
Hamilton, Montana 59840

Clearwater National Forest
Route 4, Ahsahka Road
Orofino, Idaho 83544

Custer National Forest
P.O. Box 2556
Billings, Montana 59103

Deerlodge National Forest
P.O. Box 400
Butte, Montana 59701

Flathead National Forest
P.O. Box 147
Kalispell, Montana 59901

Gallatin National Forest
P.O. Box 130
Bozeman, Montana 59715

Helena National Forest
616 Helena Avenue, Room 205
Helena, Montana 59601

Lewis and Clark National Forest
P.O. Box 871
Great Falls, Montana 59401

Lolo National Forest
Building 24, Fort Missoula
Missoula, Montana 59801

Nezperce National Forest
319 East Main
Grangeville, Idaho 83530

Boise National Forest
1075 Park Boulevard
Boise, Idaho 83706

Caribou National Forest
427 N. Sixth Avenue
Pocatello, Idaho 83201

Challis National Forest
Forest Service Building
Challis, Idaho 83226

Payette National Forest
Forest Service Building
McCall, Idaho 83638

Salmon National Forest
Forest Service Building
Salmon, Idaho 83467

Idaho Panhandle National Forests
P.O. Box 310
Coeur d'Alene, Idaho 83814

Kootenai National Forest
Box AS
Libby, Montana 59923

Sawtooth National Forest
1525 Addison Avenue East
Twin Falls, Idaho 83301

Targhee National Forest
420 North Bridge Street
St. Anthony, Idaho 83445

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